MULTIMEDIA UNIVERSITY

STUDENT ID NO

MULTIMEDIA UNIVERSITY

FINAL EXAMINATION

TRIMESTER 1, 2022/2023 (TERM ID 2215)

TAI2151 – ARTIFICIAL INTELLIGENCE FUNDAMENTALS

(All sections / Groups)

16 FEBRUARY 2023

9.00 a.m. – 11.00 a.m.

(2 hours)

INSTRUCTIONS TO STUDENTS

1. This question paper consists of **5 QUESTIONS.**
2. Attempt all questions.
3. You are allowed to use calculators in this examination.
4. Please write all your answers in the Answer Booklet provided

QUESTION 1

Assume that you have a vacuum cleaner version 1 (VC1). VC1 is classified as a simple reflex agent. Now, you want to make it a model-based reflex agent, and called it vacuum cleaner version 2 (VC2).

(a) Explain the characteristics of VC1 in terms of environment, rules and possible actions. [2.5 marks]

(b) Explain the characteristics of VC2 in terms of environment, model, and possible actions. [2.5 marks]

(c) Match the task environment of VC2 by using PEAS framework. [4 marks]

(d) Assume that an additional sensor is added to let the vacuum agent stop to move into an obstacle or boundaries of the environment. What will happen if the sensor stops working? [1 mark]

Continued.....

QUESTION 2

(a) Compare the different between a learning agent and a model-based reflex agent. [5 marks]

(b) A chessboard with 6*6 boxes is given and you need to place 6 queens on the chessboard. The queen will attack each other when another queen is found on similar rows, columns or diagonal path. The objective of the chess is to place all the queen where no queen shall attack each other.

Explain the formulation to solve the chessboard problem in terms of initial state, state space, actions, goal, and solution to be delivered. [5 marks]

Continued.....

QUESTION 3

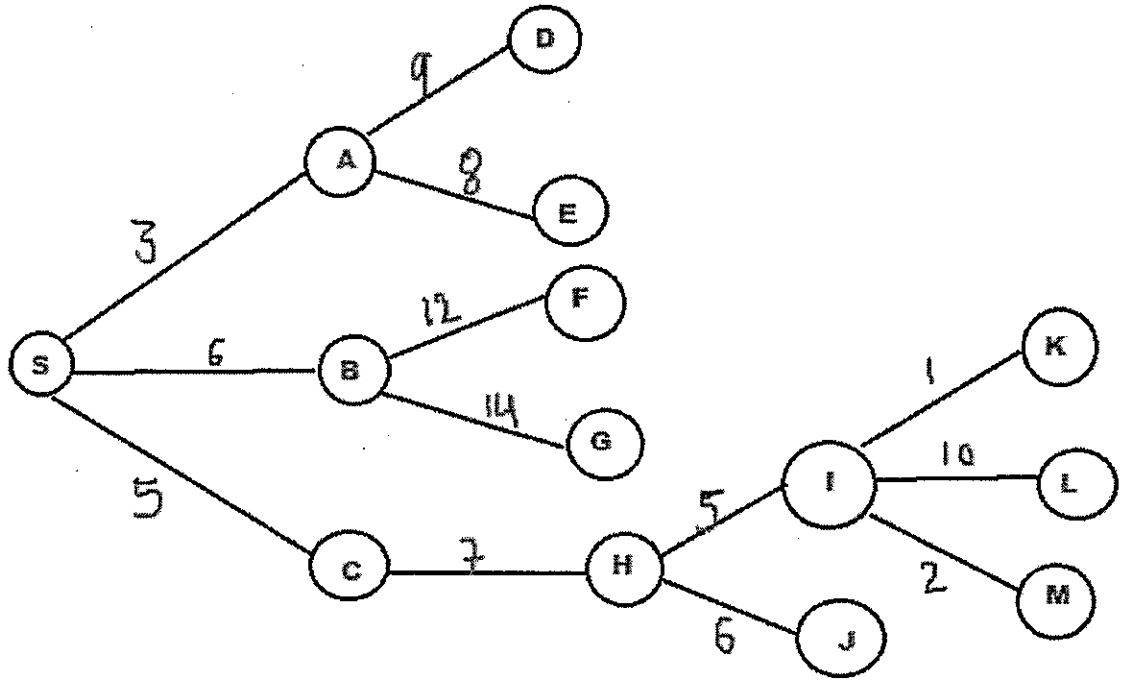

Figure 1. A Map from Node I to Node S

By referring to Figure 1, illustrate the progress of the following search algorithms:

(a) Breadth first search (uninformed search) with a table [5 marks]

(b) Greedy best-first search (informed search) with a tree [4 marks]

for finding a path from node I to node S using the **straight-line** distance heuristics as below:

Table 1. Straight Line Distant

Node	Straight line distant to S	Node	Straight line distant to S	Node	Straight line distant to S
S	0	J	11	D	12
K	12	C	5	E	10
L	20	B	6		
M	11	A	3		
I	10	G	15		
H	9	F	12		

Show the final output of nodes for each algorithm and the *f*-score for each node if any. Label the status of nodes as V (visited), N (not visited), G (goal) whenever necessary. What can you conclude after comparing the search algorithms in (a) and (b)? [1 mark]

Continued.....

QUESTION 4

Answer the following questions based on a two-player game tree in Figure 2. The evaluation values are stated below each leaf node in the game tree.

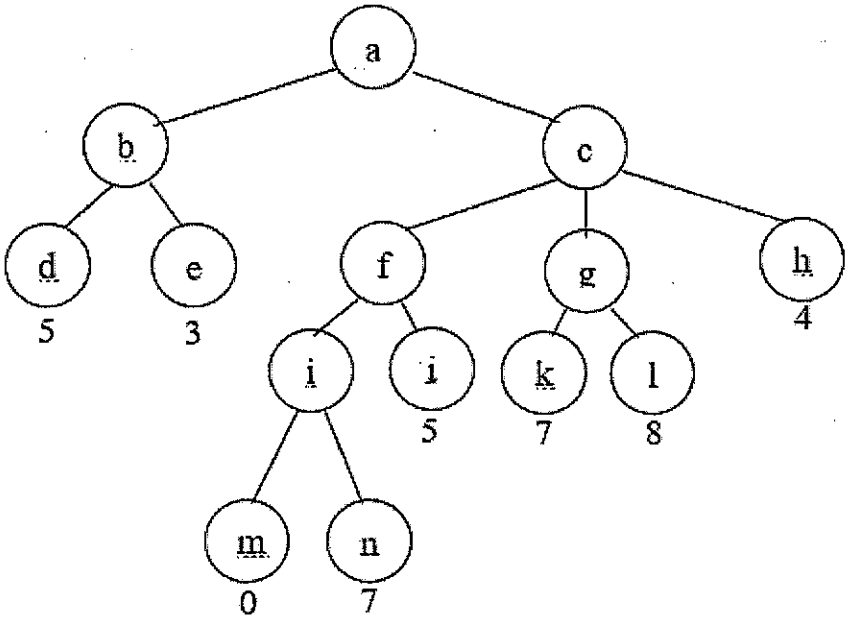

Figure 2. Two-player game tree

(a) Apply minimax algorithm to the game tree in Figure 1, where it is the Maximizer's turn to play at Node A. Redraw the game tree and use the equilateral triangle (Δ) to represent Maximizer and inverted triangle (∇) to represent the Minimizer.

[2 marks]

(b) Compute backing up values for each node with minimax algorithm. Indicate the values for nodes a, b, c, f, g and i.

[3 marks]

(c) Sersi suggests that Alpha-Beta Pruning might help to reduce the number of searching nodes for minimax algorithm. Apply the Minimax with Alpha-Beta Pruning technique to determine the optimal decision for the game tree. Note that the nodes which are pruned should be marked explicitly and show the values for α and β in each node.

[5 marks]

Continued.....

QUESTION 5

(a) Three attributes about the conditions of a used lorry are considered to decide whether or not to buy it. These attributes are the *Age*, *Size*, and *Number of Repair*. The possible values of each attributes are listed as follows.

$$\text{Age} \in \{\text{old, new}\}$$

$$\text{Size} \in \{\text{small, large}\}$$

$$\text{Number of Repair} \in \{0,1,2\}$$

A set of data samples has been collected and listed in Table 2.

Table 2. Data samples

Record ID	Age	Size	Number of Repair	Buy?
1	Old	Small	2	Yes
2	New	Small	2	No
3	Old	Large	1	No
4	New	Large	1	No
5	Old	Large	0	Yes

Note: $\log_2 1 = 0, \log_2 2 = 1, \log_2 3 = 1.58, \log_4 = 2, \log_2 5 = 2.32, \log_2 6 = 2.58$

Also, $\log\left(\frac{x}{y}\right) = \log x - \log y$.

(i) Given Remainder (Age) = 0.548, Remainder (Size) = 0.948 and Gain (Age) = 0.024, apply the **Max Gain method** to find out the root nodes of the decision tree. Show all your steps. [3.5 marks]

(ii) Draw a decision tree. [2.5 marks]

(b) Let the propositions A, B and C denote that President's youngest child is Apple, Bimbo and Casey, respectively. Given the following clauses for the relationship background:

1. $A \vee B \vee C$ (One child has to be the youngest.)
2. $\neg A \vee \neg B$ (Apple and Bimbo cannot both be the youngest.)
3. $\neg A \vee \neg C$
4. $\neg B \vee \neg C$

(i) Convert the logical statements in (5 to 7) to a clause form.

5. Apple is her youngest child if Bimbo is not her youngest child.
6. Apple is not her youngest child if Casey is not her youngest child.

[1 mark]

(ii) Prove that **Bimbo is her youngest child** by applying Proof by Contradiction. [3 marks]

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